

ON-ROAD & RAIL TRANSPORTATION

Energy
Demand
Forecasts
for California



APRIL 1999
CALIFORNIA
ENERGY
COMMISSION

Gray Davis, *Governor*

P300-99-008

STAFF REPORT

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Introduction and Summary

The on-road and rail transportation sector in California currently consumes about two quadrillion (million billion) Btu's of energy annually, and accounts for 60 percent of California's petroleum demand and 40 percent of the carbon dioxide emissions from fuel use. It is also the major source of the criteria pollutants associated with health-based air quality standards. Transportation, in all forms, is responsible for nearly 50 percent of all energy consumed in California.

This report presents forecasts of on-road and rail transportation energy demand (including gasoline, diesel, electricity, and natural gas), vehicle stock, and miles traveled (VMT) in California for cars, trucks, buses and trains. It is meant to provide information supporting the analysis of a number of issues. The energy demand forecasts are meant to help energy supply planning under a variety of potential future market conditions. The California petroleum industry faces issues of potential need for increased refining capacities and imports in view of likely increases in fuel demand and potential changes in the quality or composition of the fuels such as due to a ban on the use of methyl tertiary butyl ether (MTBE). Electric and gas utilities need to consider what impacts the refueling of alternative fuel vehicles may have on distribution systems, especially in areas with potentially higher market penetration of the vehicles. Forecasts of fuel demand by fuel type provide the basis for determining the carbon dioxide emissions under different scenarios for analyzing California's potential contribution to global climate change and the effectiveness of different scenarios to reduce the emissions. The fuel demand, vehicle stock, and VMT forecasts assist State and local agencies and private industry in examining and projecting expected energy use, revenues, emissions and other factors in the transportation sector.

The report includes the results from a base case forecast (two scenarios) and from alternatives to the base case (three scenarios). The two base case scenarios for cars and light-duty trucks, referred to as light-duty vehicles (LDVs), include the following assumptions:

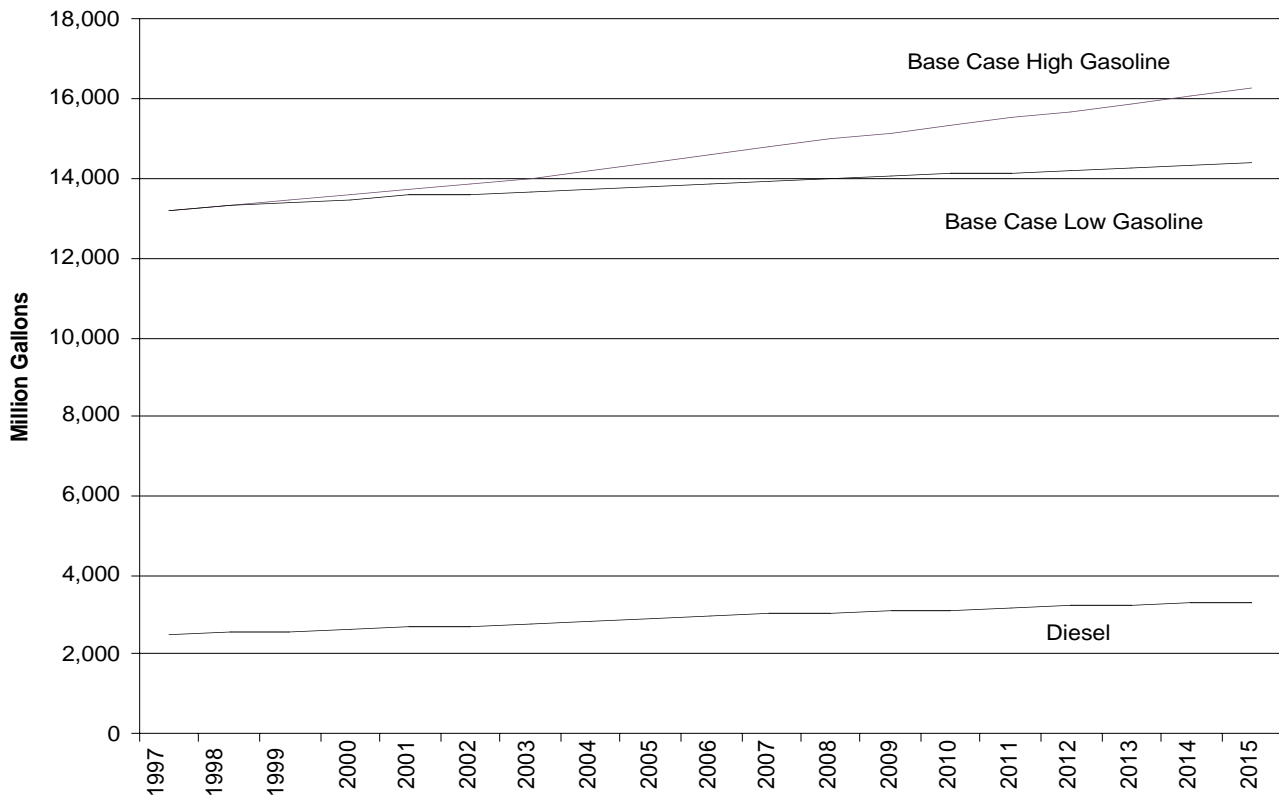
- (A) no improvement in the fuel efficiency of new LDVs and no significant market penetration of alternative fuel vehicles (AFVs);
- (B) improvement in the fuel efficiency of new LDVs and significant market penetration of AFVs.

In essence, these scenarios are primarily intended to provide high (A) and low (B) forecasts of on-road gasoline demand in California for 1997-2015. Three alternative cases are examined to determine:

- (1) The effect on gasoline demand of higher economic/demographic growth (relative to that assumed in the base case);

- (2) The effect of continued growth in sales of sport utility vehicles, at a rate equal to that of the past few years;

Figure 1: Projected On-Road Gasoline Demand, Base Case High and Low, and Projected Diesel Demand for California, 1997-2015



Source: California Energy Commission, April 1999 Staff Forecast

- (3) The near-term future of electric vehicles under an “existing technology” scenario—that is, no major cost reductions nor breakthroughs in battery technology and no change in consumer attitudes toward these vehicles.

The main results from these forecasts are the following:

- In the base case, gasoline demand is projected to increase by an average of 0.5 percent per year in the low scenario and by an average of 1.2 percent in the high scenario. Diesel demand is projected to grow by around 1.7 percent per year (the same for both the high and low gasoline cases). Results are shown in Figure 1 above. Thus, even with significant sales of AFVs and steady growth in new auto fuel efficiency, on-road gasoline demand is projected to continue to grow; by 2015 on-road gasoline use is forecast to be over 14

billion gallons per year in the low case and 16 billion in the high (up from the 1997 consumption level of roughly 13 billion).

- Growth in gasoline demand in both the high and low base scenarios is higher than in past Energy Commission baseline forecasts (documented in *1993-1994 California Transportation Energy Analysis Report* and the *Fuels Report, December 1995*) that project relatively flat demand. While sales of electric vehicles are assumed to be sufficient, in the low gasoline case, to meet the California Air Resources Board's Zero Emission Vehicle mandates, sales of natural gas vehicles are forecast to be lower than in previous forecasts, and methanol vehicles, unlike past forecasts, are not assumed to reach a significant percentage of sales.
- On-road vehicle miles traveled are expected to increase by an average of around 1.3 percent per year in the low gasoline base case and by 1.2 percent in the high gasoline case from 1997-2015. The difference is due to the higher average fuel efficiency assumed in the low case, which reduces the average per-mile (marginal) cost of driving, inducing higher VMT.
- Higher population and economic growth (roughly 0.5 to 0.75 percent higher per year than that assumed in the base case) for California would cause annual light-duty vehicle gasoline demand to increase by roughly 4.5 percent, relative to base levels, by 2005; from 1997-2005 LDV gasoline demand would increase annually by an average of 1.8 percent in the high gasoline forecast and by 1.3 percent in the low forecast.
- Continued increases in the sales of sport utility vehicles in California would increase annual LDV gasoline demand by around 2.5 percent over the high gasoline base case scenario by 2015.
- Assuming existing technology (no major breakthroughs) for electric vehicles (EVs), sales are forecast to remain relatively low, rising from an estimated 250 in 1996 to only about 1,500 in 2005.

The following section presents the main forecast results. Appendix A gives the results in more detail. A summary of the methodology used in the forecasts, along with a description of the input data, is given in Appendix B.

Forecast Results

Base Case

Assumptions

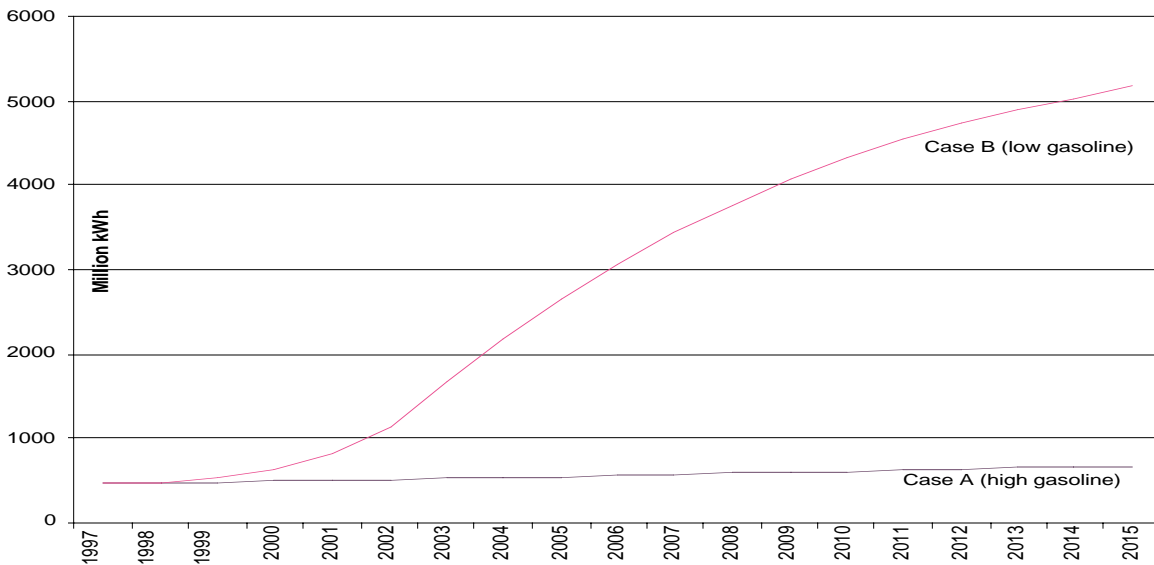
The base case forecasts (1997-2015) described below use the same DRI/McGraw Hill economic/demographic projections, and include two cases: a "high" and a "low" growth gasoline demand scenario, referred to as Cases *A* and *B*, respectively. The high growth case, *A*, assumes no significant penetration of alternative fuel vehicles and no increase in new light-duty vehicle fuel economy beyond 1997 levels. In the low growth case, *B*, electric and natural gas vehicles begin to substitute for gasoline LDVs, and new vehicle fuel efficiency is assumed to improve. In particular, Case *B* assumes that the sales of new EVs increase beginning in 1999 until ten percent of new light-duty vehicle sales are electric by 2003; this penetration level is assumed to remain constant through 2015.¹ In addition, four dedicated compressed natural gas (CNG) and two bi-fuel (CNG and gasoline) classes are included, and new LDV fuel economy (for both conventional and alternative fuel vehicles) is assumed to grow according to projections by K.G. Duleep.² Forecasts are provided for California as a whole as well as for the San Francisco, Los Angeles, San Diego, and Sacramento regions. Flexible fuel methanol vehicles are not assumed to be widely available in either case; no manufacturer is currently planning to sell methanol light-duty vehicles for model year 1999. Transit and freight results do not vary between the two cases.

Gasoline demand projections include freight, transit, and light-duty vehicle use. Diesel projections include freight and transit results, and roughly 10 percent of demand is for rail diesel. Electricity and natural gas in Case *A* include transit only (no significant penetration of electric and natural gas autos is assumed), while Case *B* includes transit and light-duty vehicle demand, assuming the ZEV requirements are met and that natural gas autos gain significantly increased acceptance in California. The projections for transit (i.e., bus) CNG reflect estimated growth through 2003³; there is currently no information nor methodology available to predict increases (if any) in the stock of natural gas buses after this year.

Results

As shown in Figure 1 in the summary above, the base case forecasts for the State show on-road gasoline demand increasing from 13.1 billion gallons in 1997 to 16.3 billion gallons in Case *A* and to 14.4 billion gallons in Case *B* by 2015. Diesel use is forecast to increase from 2.5 billion gallons in 1997 to 3.3 billion gallons by 2015 (the same in both cases). On a per capita basis, annual gasoline demand is projected to rise in Case *A* (from roughly 408 to 418 gallons) and decline in Case *B* (408 to 370).

Figure 2: Projected On-Road and Rail Electricity Demand, 1997-2015



Source: California Energy Commission, April 1999 Staff Forecast

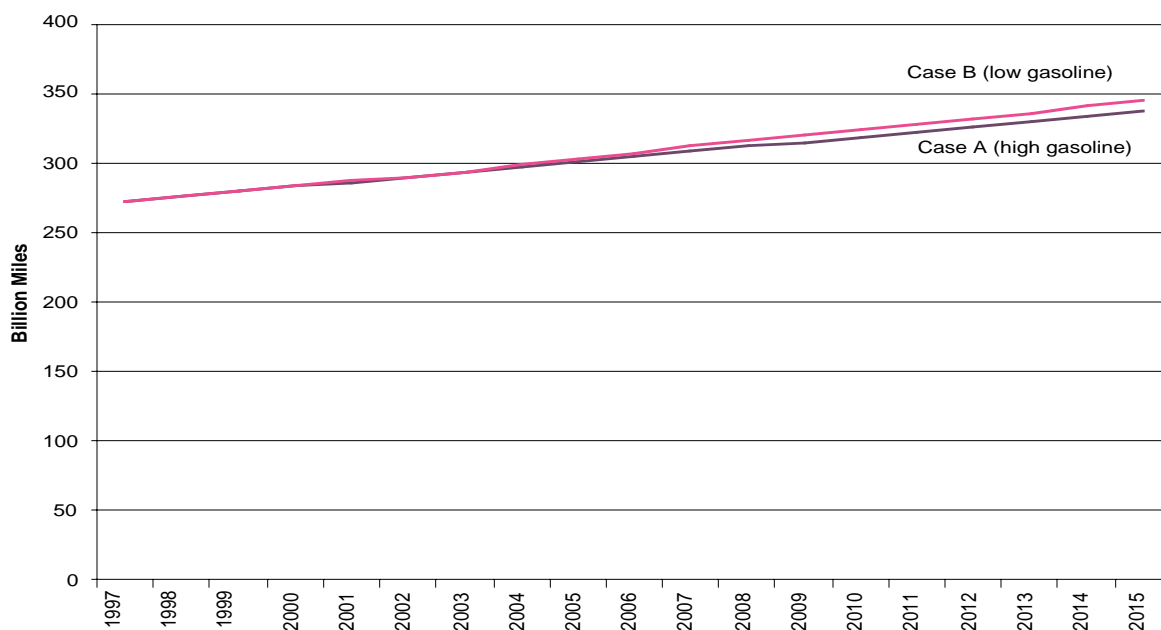
Figure 2 shows the projections for on-road and rail electricity demand for the State. Transportation electricity use is forecast to increase from around 450 million kWh in 1997 to slightly less than 700 million kWh in Case A and to over five billion kWh in Case B by 2015. Compressed natural gas demand (not shown in Figure 2) is projected to rise from nine million therms in 1997 to 38 million therms in Case A and to 87 million therms in Case B by 2015. Annual projections for the State as well as the San Francisco, Los Angeles, San Diego, and Sacramento regions for all four fuel types are given in Tables A-1 - A-5 in Appendix A.

Figure 3 illustrates the projections for vehicle miles traveled by light-duty vehicles as well as on-road freight and transit for the State for the high and low gasoline cases. The numbers for the State and four regions are given in Table A-6 in Appendix A. On-road VMT is projected to increase in California from roughly 272 billion miles in 1997 to around 338 billion miles in Case A and to 346 billion miles in Case B by 2015. In Case B (low gasoline demand scenario), the increased efficiency of conventional light-duty vehicles combined with the high-efficiency natural gas and electric vehicles reduce the average operating cost per mile and are therefore projected to increase LDV VMT relative to Case A. On a per-capita basis, VMT is projected to rise in both scenarios between 1997 and 2015: from around 8,400 in 1997 to 8,700 in Case A and 8,900 in Case B.

For Cases A and B, the difference in average miles per gasoline-equivalent gallon for LDVs can be seen in Table A-7, Appendix A. The table also includes average efficiencies for medium-

and heavy-duty trucks as well as buses for the State. In Case A, which assumes no change in the fuel economy of new LDVs, *fleet-average mpg is projected to drop slightly as*

Figure 3: Projected Annual Total On-Road VMT for California, 1997-2015



Source: California Energy Commission, April 1999 Staff Forecast

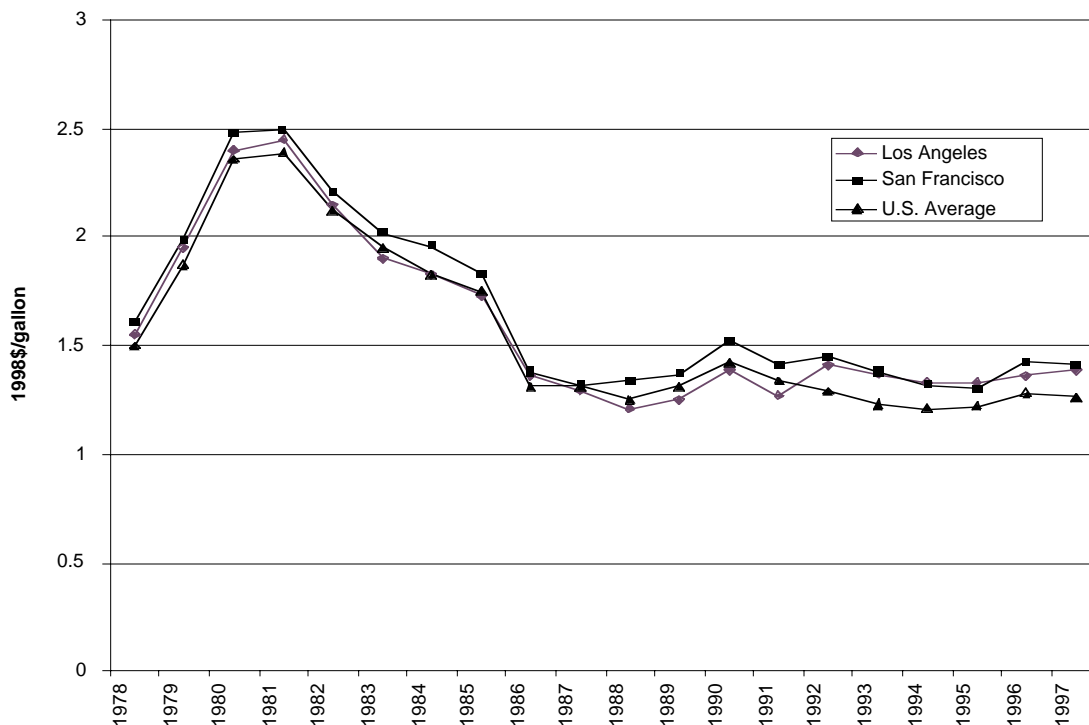
more and more of the relatively efficient smaller cars built in the late 1970's and early 1980's, when real gasoline prices were much higher than in 1997, are scrapped (Figure 4 shows the path of average real gasoline prices in Los Angeles, San Francisco, and the nation for 1978-1997). Case B assumes the introduction of additional fuel economy technologies for new LDVs in the future, which results in a projected increase in fleet-average fuel efficiency from 20 mpg in 1997 to around 22.5 mpg by 2015.

Table A-8 gives the projections for on-road vehicle stock for the State and four regions. The light-duty vehicle entries come from Case A (high gasoline case); Case B gives slightly higher projections (a maximum of less than one percent in 2015) due to the increased number of vehicle choices available. By 2015, the number of on-road vehicles is projected to reach over 29 million in California, up from slightly less than 23 million in 1997. On a per-capita basis, this change would mean an increase in the number of vehicles from around 0.71 in 1997 to 0.75 by the end of the forecast period.

In Case B, electric and natural gas vehicles are projected to constitute roughly four and one percent, respectively, of light-duty vehicle stock by 2015. Table A-9 provides light-duty vehicle stock forecasts for California by fuel type for Case B; also included is average fuel

efficiency by fuel type, in gasoline equivalent gallons. With the fuel economy improvements projected in this case, the average mpg for the LDV gasoline fleet improves from 20.0 in 1997 to 21.7 in 2015. Average efficiency for electric vehicles is projected to drop throughout most of the

Figure 4: Average Retail Unleaded Gasoline Prices



Source: California Energy Commission Fuels Office

forecast period as compact vans and pickups increase as a percentage of electric stock (initially, small cars are forecast to make up most of the EV market). On the other hand, the average efficiency for natural gas vehicles rises throughout the forecast period. This comes about as the percentage of cars rises relative to less fuel efficient trucks and vans (initially, most natural gas vehicles are projected to be commercial light trucks).

Alternative Cases

Higher Economic/Demographic Growth

The higher-growth scenarios incorporate average annual growth rates in population, income, employment, and number of households from 1997-2005 that are roughly 0.5 to 0.75 percent higher than base case assumptions (see also appendix). Two forecasts were generated for comparison with base case results: "high" and "low" gasoline demand scenarios for light-duty vehicles, as defined above, for 1997-2005; as before, the high and low cases are referred to as A

and *B*, respectively. The economic/demographic growth projections on which these scenarios are based⁴ are very aggregate in nature, so that regional forecasts as well as freight and transit projections could not be included. In addition, the projections are available only through 2005, and therefore a comparison with the base case was not feasible for the full forecast period.

Table 1: Comparison of LDV Gasoline Demand (millions of gallons)

| Year | Higher Econ./Demographic Growth | | Base Case | |
|------|---------------------------------|--------|-----------|--------|
| | Case A | Case B | Case A | Case B |
| 1997 | 12,900 | 12,900 | 12,900 | 12,900 |
| 1998 | 13,124 | 13,099 | 13,071 | 13,046 |
| 1999 | 13,337 | 13,277 | 13,224 | 13,164 |
| 2000 | 13,561 | 13,448 | 13,385 | 13,273 |
| 2001 | 13,794 | 13,613 | 13,548 | 13,370 |
| 2002 | 14,048 | 13,771 | 13,700 | 13,430 |
| 2003 | 14,297 | 13,888 | 13,860 | 13,469 |
| 2004 | 14,592 | 14,053 | 14,045 | 13,536 |
| 2005 | 14,896 | 14,223 | 14,265 | 13,635 |

Source: California Energy Commission, April 1999 Staff Forecast

Table 1 shows the results for gasoline demand, by LDVs only, for the higher-growth and base case forecasts.

The higher-growth scenarios would result in an increase of roughly 4.5 percent in gasoline demand by 2005 for both cases over the respective base case scenarios; from 1997-2005 LDV gasoline demand would increase annually by an average of 1.8 percent in the high gasoline forecast and by 1.3 percent in the low forecast. The resulting average fuel efficiency would be about the same between the two sets of economic/demographic data, so the increase in VMT (not shown) would also increase by approximately 4.5 percent by 2005. Vehicle stock would increase by a smaller amount, 4.2 percent, implying an increase in miles driven per vehicle, which is due to higher income and employment growth. The higher income growth would lead to an increase in new LDV sales of around eight percent over base case levels by 2005.

Continued Increase in the Sale of Sport Utility Vehicles

In this scenario, sport utility vehicles (SUVs) continue to rise as a percentage of new auto sales at the average rate that this increase has occurred nationwide between 1984 and 1997, using figures from *Ward's Automotive Yearbook* (California-specific figures were not available for more than three years). This rate (an increase in share of slightly less than one percent per year) means that California new SUV sales would rise, as a percentage of the total, from around 11 percent in 1995 to roughly 30 percent by 2015. The analysis projects that this increase would reduce the share of sales by new cars from 62 to 49 percent and that of pickup trucks and vans from 26 to 20 percent (relative to base case A) in 2015. The effect of this increase in SUV sales is to increase the projected number of these vehicles on the road in 2015 by roughly 1.4 million.

Gasoline demand is projected to be about 2.5 percent higher by 2015 compared to the high gasoline base case. Total driving drops by a small amount (less than one-half of one percent) as a result of the now higher average fuel cost per mile due to the increase in the number of less efficient SUVs. The drop in VMT means that fleet-average fuel efficiency drops in magnitude by slightly more than the increase in gasoline demand, around three percent.

Existing Technology for Electric Vehicles

While Case A assumes no significant number of alternative fuel LDVs and Case B assumes that EV purchases will reach ten percent of new LDV sales by 2003, this scenario examines more closely the near-term future of personal (non-commercial fleet) electric vehicles, assuming no major cost reductions, no breakthroughs in battery technology, and no change in consumer attitudes toward these vehicles. For this purpose, electric vehicle characteristics are those projected by K.G. Duleep and Commission staff. The utility of EVs is adjusted, or calibrated, so that the sales of electric vehicles match the estimated number of General Motors EV1 (assigned to the subcompact class) leases in 1996-1997, which is estimated to be 250 in California. Three additional classes of EVs, minicar, compact pickup, and compact van, are assumed to be available to the general public by the year 2000.

Aside from the vehicle characteristics that are explicit in the utility functions, gasoline and alternative fuel vehicles of the same class are assumed to have no significant differences and, therefore, are assigned the same calibration constants⁵. Calibration of electric subcompact cars to actual EV1 leases amounts to an attempt to account for other factors, such as consumer caution with regard to a new technology, that has to this point served to limit EV sales. The calibration constants of the other EV classes expected to be available (mini, compact pickup, compact van) are then adjusted to reflect the difference between the new calibration constant for the EV subcompact class and the constant for the gasoline standard subcompact class. CNG vehicles were not included here so that, in a sense, this scenario represents a minimum-market

penetration case for AFVs: a forecast with the assumption that EVs remain a novelty to the public in general, with high acquisition and battery replacement costs and continued limited range. Table 2 shows the results of this forecast by EV class and model year for California. Without major changes in EV characteristics and in consumer attitudes, personal EV sales are projected to remain very low, reaching only around 1,500 by 2005.

Table 2: Sales of EVs by Class and Model Year (calibrated to EV1 leases)

| EV Class | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|----------------|------|------|------|------|------|-------|-------|-------|-------|
| Minicar | | | 110 | 119 | 132 | 147 | 162 | 179 | 197 |
| Subcompact | 250 | 240 | 292 | 321 | 363 | 410 | 456 | 512 | 574 |
| Compact pickup | | | 182 | 177 | 179 | 209 | 238 | 271 | 311 |
| Compact van | | | | 236 | 273 | 320 | 366 | 419 | 478 |
| Total | 250 | 240 | 584 | 853 | 947 | 1,086 | 1,222 | 1,381 | 1,560 |

Source: California Energy Commission, April 1999 Staff Forecast

Appendix A: Tables of Forecast Results

Table A-1: Projected Statewide Transportation Fuel Demand

| Year | Gasoline (million gallons) | | Comp. Natural Gas (million therms) | | Electricity (million kWh) | | Diesel (mil. gals.) |
|------|-------------------------------|--------|---------------------------------------|--------|------------------------------|--------|------------------------|
| | Case A | Case B | Case A | Case B | Case A | Case B | |
| 1997 | 13,151 | 13,151 | 9 | 9 | 459 | 459 | 2,482 |
| 1998 | 13.306 | 13.281 | 12 | 24 | 468 | 468 | 2.540 |
| 1999 | 13.438 | 13.378 | 15 | 34 | 479 | 530 | 2.591 |
| 2000 | 13.579 | 13.467 | 19 | 56 | 490 | 642 | 2.648 |
| 2001 | 13.732 | 13.554 | 27 | 38 | 501 | 826 | 2.696 |
| 2002 | 13.871 | 13.601 | 32 | 64 | 513 | 1,141 | 2.734 |
| 2003 | 14.025 | 13.634 | 38 | 73 | 524 | 1,665 | 2.779 |
| 2004 | 14.198 | 13.689 | 38 | 75 | 536 | 2,179 | 2.846 |
| 2005 | 14.409 | 13.779 | 38 | 76 | 547 | 2,647 | 2.914 |
| 2006 | 14.598 | 13.852 | 38 | 77 | 559 | 3,069 | 2.970 |
| 2007 | 14.800 | 13.930 | 38 | 79 | 571 | 3,456 | 3.018 |
| 2008 | 14.972 | 13.982 | 38 | 80 | 583 | 3,774 | 3.065 |
| 2009 | 15.149 | 14.036 | 38 | 81 | 595 | 4,067 | 3.107 |
| 2010 | 15.345 | 14.108 | 38 | 82 | 607 | 4,329 | 3.151 |
| 2011 | 15.522 | 14.160 | 38 | 83 | 620 | 4,553 | 3.193 |
| 2012 | 15.678 | 14.198 | 38 | 84 | 632 | 4,742 | 3.234 |
| 2013 | 15.854 | 14.257 | 38 | 85 | 645 | 4,901 | 3.277 |
| 2014 | 16.057 | 14.345 | 38 | 86 | 658 | 5,043 | 3.316 |
| 2015 | 16.263 | 14.430 | 38 | 87 | 671 | 5,183 | 3.348 |

Source: California Energy Commission, April 1999 Staff Forecast

Table A-2: Projected Transportation Fuel Demand for San Francisco Region

| Year | Gasoline | | Comp. Natural Gas | | Electricity | | Diesel (mil. gals.) |
|------|-------------------|--------|-------------------|--------|---------------|--------|------------------------|
| | (million gallons) | | (million therms) | | (million kWh) | | |
| | Case A | Case B | Case A | Case B | Case A | Case B | |
| 1997 | 2.582 | 2.582 | 0 | 0 | 353 | 353 | 476 |
| 1998 | 2.604 | 2.598 | 0 | 3 | 360 | 360 | 488 |
| 1999 | 2.625 | 2.611 | 0 | 4 | 368 | 381 | 498 |
| 2000 | 2.650 | 2.624 | 0 | 5 | 377 | 416 | 509 |
| 2001 | 2.681 | 2.641 | 0 | 6 | 385 | 467 | 519 |
| 2002 | 2.704 | 2.644 | 0 | 7 | 393 | 547 | 526 |
| 2003 | 2.732 | 2.644 | 0 | 7 | 402 | 672 | 535 |
| 2004 | 2.762 | 2.649 | 0 | 8 | 410 | 789 | 547 |
| 2005 | 2.802 | 2.663 | 0 | 8 | 418 | 894 | 561 |
| 2006 | 2.838 | 2.674 | 0 | 8 | 427 | 990 | 572 |
| 2007 | 2.869 | 2.680 | 0 | 8 | 435 | 1,073 | 581 |
| 2008 | 2.904 | 2.690 | 0 | 9 | 444 | 1,140 | 590 |
| 2009 | 2.935 | 2.697 | 0 | 9 | 452 | 1,203 | 598 |
| 2010 | 2.967 | 2.704 | 0 | 9 | 461 | 1,261 | 607 |
| 2011 | 2.999 | 2.712 | 0 | 9 | 469 | 1,310 | 614 |
| 2012 | 3.027 | 2.716 | 0 | 9 | 478 | 1,353 | 622 |
| 2013 | 3.055 | 2.722 | 0 | 9 | 486 | 1,386 | 630 |
| 2014 | 3.085 | 2.732 | 0 | 9 | 495 | 1,416 | 637 |
| 2015 | 3.109 | 2.736 | 0 | 9 | 504 | 1,442 | 643 |

Source: California Energy Commission, April 1999 Staff Forecast

Table A-3: Projected Transportation Fuel Demand for Los Angeles Region

| Year | Gasoline | | Comp. Natural Gas | | Electricity | | Diesel (mil. gals.) |
|------|-------------------|--------|-------------------|--------|---------------|--------|------------------------|
| | (million gallons) | | (million therms) | | (million kWh) | | |
| | Case A | Case B | Case A | Case B | Case A | Case B | |
| 1997 | 6.325 | 6.325 | 4 | 4 | 66 | 66 | 1.015 |
| 1998 | 6.395 | 6.383 | 7 | 13 | 67 | 67 | 1.040 |
| 1999 | 6.458 | 6.427 | 10 | 19 | 68 | 94 | 1.061 |
| 2000 | 6.527 | 6.469 | 13 | 25 | 69 | 147 | 1.086 |
| 2001 | 6.600 | 6.509 | 19 | 33 | 71 | 239 | 1.106 |
| 2002 | 6.660 | 6.522 | 24 | 40 | 72 | 397 | 1.122 |
| 2003 | 6.729 | 6.529 | 29 | 46 | 74 | 667 | 1.141 |
| 2004 | 6.809 | 6.549 | 29 | 47 | 75 | 929 | 1.169 |
| 2005 | 6.909 | 6.587 | 29 | 47 | 76 | 1.164 | 1.198 |
| 2006 | 7.006 | 6.623 | 29 | 48 | 78 | 1.377 | 1.222 |
| 2007 | 7.082 | 6.638 | 29 | 48 | 79 | 1.555 | 1.242 |
| 2008 | 7.169 | 6.665 | 29 | 49 | 81 | 1.704 | 1.261 |
| 2009 | 7.256 | 6.691 | 29 | 49 | 82 | 1.839 | 1.279 |
| 2010 | 7.333 | 6.708 | 29 | 50 | 83 | 1.952 | 1.298 |
| 2011 | 7.443 | 6.752 | 29 | 50 | 85 | 2.069 | 1.315 |
| 2012 | 7.519 | 6.769 | 29 | 51 | 86 | 2.162 | 1.332 |
| 2013 | 7.611 | 6.799 | 29 | 51 | 88 | 2.243 | 1.349 |
| 2014 | 7.676 | 6.812 | 29 | 51 | 89 | 2.295 | 1.365 |
| 2015 | 7.760 | 6.839 | 29 | 52 | 90 | 2.347 | 1.379 |

Source: California Energy Commission, April 1999 Staff Forecast

Table A-4: Projected Transportation Fuel Demand for San Diego Region

| Year | Gasoline (million gallons) | | Comp. Natural Gas (million therms) | | Electricity (million kWh) | | Diesel (mil. gals.) |
|------|-------------------------------|--------|---------------------------------------|--------|------------------------------|--------|------------------------|
| | Case A | Case B | Case A | Case B | Case A | Case B | |
| 1997 | 1.089 | 1.089 | 2 | 2 | 28 | 28 | 99 |
| 1998 | 1.101 | 1.098 | 2 | 3 | 29 | 29 | 102 |
| 1999 | 1.112 | 1.107 | 2 | 4 | 30 | 33 | 104 |
| 2000 | 1.124 | 1.115 | 3 | 5 | 31 | 40 | 107 |
| 2001 | 1.137 | 1.123 | 4 | 7 | 32 | 52 | 109 |
| 2002 | 1.148 | 1.127 | 4 | 7 | 33 | 75 | 111 |
| 2003 | 1.162 | 1.130 | 4 | 7 | 34 | 119 | 113 |
| 2004 | 1.178 | 1.136 | 4 | 8 | 36 | 164 | 116 |
| 2005 | 1.198 | 1.145 | 4 | 8 | 37 | 205 | 120 |
| 2006 | 1.217 | 1.154 | 4 | 8 | 38 | 244 | 122 |
| 2007 | 1.237 | 1.162 | 4 | 8 | 40 | 279 | 125 |
| 2008 | 1.255 | 1.169 | 4 | 8 | 42 | 309 | 127 |
| 2009 | 1.270 | 1.174 | 4 | 8 | 43 | 337 | 129 |
| 2010 | 1.286 | 1.179 | 4 | 8 | 45 | 362 | 131 |
| 2011 | 1.301 | 1.183 | 4 | 8 | 47 | 383 | 133 |
| 2012 | 1.313 | 1.184 | 4 | 8 | 49 | 404 | 135 |
| 2013 | 1.328 | 1.189 | 4 | 8 | 51 | 423 | 137 |
| 2014 | 1.345 | 1.196 | 4 | 9 | 53 | 436 | 139 |
| 2015 | 1.359 | 1.203 | 4 | 9 | 55 | 446 | 141 |

Source: California Energy Commission, April 1999 Staff Forecast

Table A-5: Projected Transportation Fuel Demand for Sacramento Region

| Year | Gasoline (million gallons) | | Comp. Natural Gas (million therms) | | Electricity (million kWh) | | Diesel (mil. gals.) |
|------|-------------------------------|--------|---------------------------------------|--------|------------------------------|--------|------------------------|
| | Case A | Case B | Case A | Case B | Case A | Case B | |
| 1997 | 700 | 700 | 2 | 2 | 12 | 12 | 135 |
| 1998 | 710 | 709 | 2 | 3 | 13 | 13 | 138 |
| 1999 | 721 | 718 | 2 | 4 | 13 | 15 | 140 |
| 2000 | 732 | 726 | 2 | 4 | 13 | 20 | 143 |
| 2001 | 743 | 734 | 3 | 5 | 14 | 28 | 146 |
| 2002 | 753 | 739 | 3 | 5 | 14 | 42 | 148 |
| 2003 | 765 | 745 | 4 | 7 | 15 | 69 | 150 |
| 2004 | 777 | 750 | 4 | 7 | 15 | 97 | 154 |
| 2005 | 791 | 758 | 4 | 7 | 16 | 124 | 158 |
| 2006 | 806 | 765 | 4 | 7 | 16 | 149 | 161 |
| 2007 | 817 | 770 | 4 | 7 | 17 | 174 | 163 |
| 2008 | 833 | 778 | 4 | 7 | 17 | 192 | 166 |
| 2009 | 846 | 785 | 4 | 7 | 18 | 210 | 168 |
| 2010 | 858 | 790 | 4 | 7 | 19 | 225 | 170 |
| 2011 | 871 | 796 | 4 | 7 | 19 | 238 | 173 |
| 2012 | 884 | 802 | 4 | 7 | 20 | 246 | 175 |
| 2013 | 900 | 811 | 4 | 7 | 21 | 257 | 177 |
| 2014 | 911 | 816 | 4 | 8 | 21 | 263 | 179 |
| 2015 | 923 | 821 | 4 | 8 | 22 | 269 | 181 |

Source: California Energy Commission, April 1999 Staff Forecast

Table A-6: Projected Total On-Road VMT by Region
(billions of miles)

| Year | State | | San Francisco | | Los Angeles | | San Diego | | Sacramento | |
|------|--------|--------|---------------|--------|-------------|--------|-----------|--------|------------|--------|
| | Case A | Case B | Case A | Case B | Case A | Case B | Case A | Case B | Case A | Case B |
| 1997 | 272.3 | 272.3 | 54.3 | 54.3 | 131.1 | 131.1 | 22.6 | 22.6 | 14.2 | 14.2 |
| 1998 | 276.4 | 276.5 | 54.9 | 55.0 | 133.0 | 133.0 | 22.9 | 22.9 | 14.5 | 14.5 |
| 1999 | 279.8 | 280.0 | 55.5 | 55.6 | 134.5 | 134.6 | 23.2 | 23.2 | 14.8 | 14.8 |
| 2000 | 283.3 | 283.5 | 56.2 | 56.2 | 136.1 | 136.3 | 23.5 | 23.5 | 15.0 | 15.0 |
| 2001 | 286.7 | 287.2 | 56.9 | 57.0 | 137.7 | 138.0 | 23.7 | 23.7 | 15.2 | 15.3 |
| 2002 | 290.0 | 290.6 | 57.5 | 57.6 | 139.1 | 139.5 | 23.9 | 24.0 | 15.5 | 15.5 |
| 2003 | 293.3 | 294.4 | 58.1 | 58.3 | 140.6 | 141.2 | 24.2 | 24.3 | 15.7 | 15.8 |
| 2004 | 297.2 | 298.8 | 58.8 | 59.2 | 142.3 | 143.2 | 24.6 | 24.7 | 16.0 | 16.1 |
| 2005 | 301.1 | 303.2 | 59.6 | 60.0 | 144.2 | 145.3 | 24.9 | 25.1 | 16.2 | 16.4 |
| 2006 | 304.7 | 307.4 | 60.3 | 60.8 | 146.0 | 147.4 | 25.3 | 25.5 | 16.5 | 16.6 |
| 2007 | 308.5 | 311.9 | 60.9 | 61.5 | 147.4 | 149.1 | 25.6 | 26.0 | 16.7 | 16.9 |
| 2008 | 311.9 | 315.9 | 61.6 | 62.3 | 149.1 | 151.1 | 26.0 | 26.4 | 17.0 | 17.2 |
| 2009 | 315.2 | 319.9 | 62.2 | 63.1 | 150.7 | 153.0 | 26.3 | 26.7 | 17.3 | 17.5 |
| 2010 | 319.1 | 324.4 | 62.8 | 63.8 | 152.2 | 154.8 | 26.6 | 27.1 | 17.5 | 17.8 |
| 2011 | 322.5 | 328.4 | 63.5 | 64.6 | 154.3 | 157.2 | 26.9 | 27.4 | 17.8 | 18.1 |
| 2012 | 325.8 | 332.4 | 64.1 | 65.3 | 155.9 | 159.2 | 27.1 | 27.7 | 18.0 | 18.4 |
| 2013 | 329.4 | 336.5 | 64.6 | 66.0 | 157.8 | 161.3 | 27.4 | 28.1 | 18.3 | 18.7 |
| 2014 | 333.5 | 341.4 | 65.3 | 66.7 | 159.2 | 163.0 | 27.8 | 28.5 | 18.6 | 19.0 |
| 2015 | 337.8 | 346.1 | 65.8 | 67.3 | 160.9 | 164.9 | 28.1 | 28.8 | 18.8 | 19.3 |

Source: California Energy Commission, April 1999 Staff Forecast

**Table A-7: Projected Fuel Efficiency by Vehicle Type
(miles per gasoline-equivalent gallon)**

| Year | Light-duty Vehicles | | Medium- and Heavy-duty Trucks * | Buses * |
|------|---------------------|--------|------------------------------------|---------|
| | Case A | Case B | | |
| 1997 | 20.00 | 20.00 | 5.00 | 4.77 |
| 1998 | 20.03 | 20.06 | 5.01 | 4.74 |
| 1999 | 20.04 | 20.12 | 5.02 | 4.71 |
| 2000 | 20.04 | 20.19 | 5.03 | 4.68 |
| 2001 | 20.04 | 20.28 | 5.04 | 4.66 |
| 2002 | 20.04 | 20.42 | 5.04 | 4.63 |
| 2003 | 20.03 | 20.60 | 5.05 | 4.61 |
| 2004 | 20.02 | 20.77 | 5.05 | 4.60 |
| 2005 | 19.96 | 20.89 | 5.06 | 4.58 |
| 2006 | 19.92 | 21.03 | 5.07 | 4.57 |
| 2007 | 19.88 | 21.19 | 5.07 | 4.55 |
| 2008 | 19.85 | 21.35 | 5.07 | 4.54 |
| 2009 | 19.82 | 21.52 | 5.07 | 4.53 |
| 2010 | 19.80 | 21.69 | 5.07 | 4.52 |
| 2011 | 19.77 | 21.86 | 5.07 | 4.51 |
| 2012 | 19.77 | 22.05 | 5.07 | 4.50 |
| 2013 | 19.76 | 22.22 | 5.07 | 4.48 |
| 2014 | 19.75 | 22.38 | 5.07 | 4.48 |
| 2015 | 19.75 | 22.55 | 5.07 | 4.47 |

* Includes gasoline and diesel only.

Source: California Energy Commission, April 1999 Staff Forecast

**Table A-8: Projected Total Stock of Light-Duty Vehicles (LDV)
and Medium and Heavy Duty Trucks (MHDT) by Region (thousands)**

| Year | State | | San Francisco | | Los Angeles | | San Diego | | Sacramento | |
|------|--------|------|---------------|------|-------------|------|-----------|------|------------|------|
| | LDV | MHDT | LDV | MHDT | LDV | MHDT | LDV | MHDT | LDV | MHDT |
| 1997 | 22.539 | 288 | 4.737 | 55 | 10.427 | 125 | 1.853 | 12 | 1.217 | 15 |
| 1998 | 22.873 | 290 | 4.789 | 56 | 10.562 | 126 | 1.876 | 13 | 1.239 | 15 |
| 1999 | 23.179 | 290 | 4.844 | 56 | 10.691 | 126 | 1.899 | 13 | 1.263 | 15 |
| 2000 | 23.484 | 297 | 4.901 | 57 | 10.827 | 129 | 1.923 | 13 | 1.286 | 16 |
| 2001 | 23.796 | 297 | 4.963 | 57 | 10.966 | 129 | 1.947 | 13 | 1.308 | 15 |
| 2002 | 24.114 | 297 | 5.018 | 57 | 11.097 | 129 | 1.970 | 13 | 1.330 | 16 |
| 2003 | 24.447 | 299 | 5.077 | 58 | 11.236 | 130 | 1.996 | 13 | 1.355 | 16 |
| 2004 | 24.805 | 306 | 5.142 | 59 | 11.387 | 133 | 2.025 | 13 | 1.380 | 16 |
| 2005 | 25.233 | 310 | 5.225 | 60 | 11.571 | 135 | 2.060 | 13 | 1.408 | 16 |
| 2006 | 25.620 | 316 | 5.294 | 61 | 11.742 | 138 | 2.093 | 13 | 1.436 | 16 |
| 2007 | 26.023 | 315 | 5.357 | 61 | 11.891 | 137 | 2.127 | 13 | 1.460 | 16 |
| 2008 | 26.376 | 317 | 5.422 | 61 | 12.048 | 138 | 2.157 | 13 | 1.485 | 17 |
| 2009 | 26.730 | 323 | 5.487 | 62 | 12.195 | 140 | 2.187 | 14 | 1.511 | 17 |
| 2010 | 27.096 | 327 | 5.553 | 63 | 12.340 | 142 | 2.217 | 14 | 1.535 | 17 |
| 2011 | 27.438 | 329 | 5.618 | 63 | 12.482 | 143 | 2.245 | 14 | 1.559 | 17 |
| 2012 | 27.770 | 335 | 5.676 | 65 | 12.628 | 146 | 2.274 | 14 | 1.584 | 17 |
| 2013 | 28.126 | 332 | 5.736 | 64 | 12.773 | 144 | 2.304 | 14 | 1.615 | 17 |
| 2014 | 28.478 | 339 | 5.799 | 65 | 12.904 | 147 | 2.334 | 14 | 1.639 | 17 |
| 2015 | 28.819 | 344 | 5.854 | 66 | 13.065 | 150 | 2.363 | 14 | 1.662 | 18 |

Source: California Energy Commission, April 1999 Staff Forecast

**Table A-9: Case B Light-duty Vehicle Stock (thousands)
and Fuel Efficiency by Fuel Type**

| Year | Gasoline (mpg) | Electricity (miles/kWh) | CNG (miles/therm) |
|------|----------------|-------------------------|-------------------|
| 1997 | 22.539 (20.00) | — | — |
| 1998 | 22.837 (20.06) | — | 38 (17.35) |
| 1999 | 23.103 (20.10) | 14 (3.45) | 68 (17.75) |
| 2000 | 23.354 (20.16) | 41 (3.39) | 96 (18.31) |
| 2001 | 23.597 (20.21) | 87 (3.37) | 124 (18.53) |
| 2002 | 23.816 (20.29) | 166 (3.35) | 148 (18.80) |
| 2003 | 24.012 (20.37) | 293 (3.32) | 167 (19.02) |
| 2004 | 24.236 (20.44) | 421 (3.30) | 185 (19.18) |
| 2005 | 24.533 (20.48) | 540 (3.29) | 197 (19.33) |
| 2006 | 24.813 (20.54) | 651 (3.28) | 209 (19.49) |
| 2007 | 25.107 (20.63) | 756 (3.27) | 223 (19.68) |
| 2008 | 25.369 (20.74) | 846 (3.27) | 234 (19.88) |
| 2009 | 25.638 (20.87) | 930 (3.26) | 243 (20.10) |
| 2010 | 25.931 (21.00) | 1,008 (3.26) | 253 (20.32) |
| 2011 | 26.203 (21.13) | 1,075 (3.26) | 262 (20.52) |
| 2012 | 26.481 (21.29) | 1,133 (3.26) | 271 (20.71) |
| 2013 | 26.786 (21.44) | 1,182 (3.27) | 281 (20.89) |
| 2014 | 27.131 (21.59) | 1,225 (3.27) | 291 (21.07) |
| 2015 | 27.425 (21.74) | 1,270 (3.27) | 300 (21.24) |

Source: California Energy Commission, April 1999 Staff Forecast

Appendix B: Methodology and Input Data

Forecasting Models

This section provides a brief description of the models used by staff to generate the forecasts described above. For readers interested in more detail, full documentation is available for each model from the Energy Commission's Demand Analysis Office.

CALCARS

The California Light Duty Vehicle Conventional and Alternative Fuel Response Simulator (CALCARS) is a personal light-duty vehicle forecasting methodology that the Energy Commission currently uses to projects number and type of light-duty vehicles (LDVs) owned, along with annual vehicle miles traveled (VMT) and fuel consumption by personal cars and light-duty trucks. Patterned after the Personal Vehicle Model (PVM), developed in 1983 for the Energy Commission, CALCARS uses a nested multinomial logit structure for vehicle ownership and choice. Unlike the PVM and other vehicle choice models however, CALCARS combines stated (hypothetical) and revealed (actual) preference data to forecast the penetration and use of both conventional and alternative fuel vehicles (AFVs). Coefficients for vehicle characteristics such as range, fuel availability, and emissions are estimated simultaneously with "conventional" characteristics such as operating cost and vehicle price in the vehicle choice portions of CALCARS. In the VMT submodel estimation, the stated effects of range and fuel availability on travel are combined with data on the use of currently held vehicles.

Currently, the model can accommodate up to 35 classes of vehicles, 17 vintages, and the following fuel types: gasoline, methanol (M85), compressed natural gas (CNG), and electricity. Because CALCARS analyzes vehicle ownership and operation decisions at the household level, it can generate forecasts for any geographic region for which the necessary input data can be assembled. The Commission currently produces forecasts for five California regions (San Francisco, Los Angeles, San Diego, Sacramento, and rest of State, defined in Table B-1) as well as a statewide forecast. In the base year (1995), projections for each gasoline class-vintage combination (e.g., 5 year-old subcompact car) are calibrated to actual totals using data from the California Department of Motor Vehicles (the most recent fully processed DMV numbers available at the time these forecasts were made were from 1995). Fuel use is scaled so that 1997 LDV gasoline demand estimated by CALCARS matches historical levels in the five regions and statewide.

Gasoline commercial fleet LDVs are projected by CALCARS through forecasts from the Freight Model (described below) so that total (commercial plus personal) light-duty vehicle projections can be generated. The forecasts from the Freight Model are assigned to individual

vintages using 1995 DMV data. Exogenous fleet AFV sales projections are input into CALCARS based on staff analysis.

Table B-1: Energy Commission Forecast Regions (counties contained in each region)

| Region | Counties |
|------------------|---|
| 1. San Francisco | Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma, San Francisco |
| 2. Los Angeles | Imperial, Los Angeles, Orange, Riverside, San Bernardino, Ventura |
| 3. San Diego | San Diego |
| 4. Sacramento | El Dorado, Placer, Sacramento, Yolo |
| 5. Rest of State | All Other Counties |

Source: California Energy Commission, Demand Analysis Office

Freight Model

The Freight Model serves two purposes in the current analysis. First, it projects the volume of freight transported by truck and rail, truck stock and VMT, along with truck and rail consumption of gasoline, diesel, methanol, and liquefied petroleum gas (LPG). These outputs are driven by projections of industrial activity by economic sector in the region or statewide. Second, it provides projections for commercial light-duty vehicles, which are used as inputs into CALCARS.

Transit Model

The Transit Model forecasts transit activity and energy demand for urban bus and rail systems, intercity bus and rail systems, school buses, and other (charter, church, etc.) buses. Based on individual systems (e.g., BART), the Transit Model can provide forecasts both regionally and statewide. The model is driven primarily by projections of population, employment, and income. It is also sensitive to changes in transit fares, auto operating costs, and service policies.

Input Data

Economic and Demographic Inputs

The base case forecasts use DRI/McGraw Hill economic/demographic data.⁶ Annual growth rates for population, number of households, employment, and per-household income average roughly 1.0, 1.3, 1.2, and 0.9 percent, respectively, over the forecast period. The forecasts that assume higher near-term (1997-2005) economic/demographic growth use projections from the Center for Continuing Study of the California Economy⁷ (CCSCE). According to the DRI projections, population, number of households, employment, and per-household income are forecast to grow by roughly 1.1, 1.2, 1.5, and 1.0 percent per year, respectively, between 1997 and 2005. In the CCSCE case, the corresponding growth rates are 1.85, 1.9, 2.2, and 1.5 percent.⁸

Fuel Price Inputs

The real prices of gasoline and diesel are assumed to remain constant over the forecast periods, per the most recent projections from the Commission's Fuels Office (*California Petroleum Transportation Fuels Price Forecasts*, Commission staff report, May 1998). Compressed natural gas and electricity price projections come from three sources: the *Transportation Fuels Price Analysis*, Commission staff report, October 1995; *Natural Gas Market Outlook* (appendices), Commission staff report, June 1998; and the *Retail Electricity Price Forecast*, Commission Website, December, 1997. Table B-2 shows the projected prices for 1997, 2005, and 2015.

Table B-2: Projected Retail Fuel Prices (1998 dollars, including taxes)

| FUEL | 1997 | 2005 | 2015 |
|-----------------------|--------|--------|--------|
| Gasoline (per gallon) | \$1.31 | \$1.31 | \$1.31 |
| Diesel (per gallon) | \$1.36 | \$1.36 | \$1.36 |
| CNG (per therm) | \$1.07 | \$0.93 | \$0.93 |
| Electricity (per kWh) | \$0.08 | \$0.06 | \$0.06 |

Source: California Energy Commission Fuels Office

Vehicle Attributes and Technology

In the gasoline-only runs, CALCARS includes 20 classes of vehicles. For the runs that include alternative fuel vehicles, a maximum of 10 additional classes are included, four of which are dedicated CNG, two are bi-fuel (CNG/gasoline), and four are electric. Table B-3 gives a description of the 30 classes. Table B-4 presents the vehicle attributes that are used in the vehicle choice submodels of CALCARS, along with a brief description. Projected and historical values for vehicle price, fuel efficiency, acceleration, range, emissions, top speed, and electric vehicle battery replacement cost come from K.G. Duleep (Environmental Analysis Inc.) a recognized expert in vehicle technology. All of the other attributes come from Energy Commission analysis.

Except for one of the forecast scenarios discussed in this report, the AFV classes are assigned the same calibration constants (described in more detail in the next section) as similar gasoline vehicles, using the standard category when a class is split (e.g., the subcompact electric car is assigned the constant estimated for standard gasoline subcompacts). As an example, Table B-5 provides projected attributes for standard gasoline (for the "low" demand scenario described in the next section), CNG, and electric subcompact cars, for 2000, 2005, 2010, and 2015.

Table B-3: CALCARS Size Classes

| Class | Fuel Type | Description | Example |
|-------|-----------|----------------------------|------------------------|
| 1 | Gasoline | Mini Car | Chevrolet Chevette |
| 2 | Gasoline | Subcompact Car (luxury) | Audi 90 |
| 3 | Gasoline | Subcompact Car (standard) | Geo Prizm |
| 4 | Gasoline | Compact Car (luxury) | Mercedes 300 |
| 5 | Gasoline | Compact Car (standard) | Chrysler Lebaron |
| 6 | Gasoline | Midsize Car (luxury) | Volvo 850 |
| 7 | Gasoline | Midsize Car (standard) | Oldsmobile Cutlass |
| 8 | Gasoline | Large Car (luxury) | Cadillac Fleetwood |
| 9 | Gasoline | Large Car (standard) | Chevrolet Caprice |
| 10 | Gasoline | Sports Car (luxury) | Dodge Stealth |
| 11 | Gasoline | Sports Car (standard) | Chevrolet Camaro |
| 12 | Gasoline | Compact Pickup | Ford Ranger |
| 13 | Gasoline | Standard Pickup (luxury) | Dodge W300 |
| 14 | Gasoline | Standard Pickup (standard) | Ford F-150 |
| 15 | Gasoline | Compact Van | Plymouth Grand Voyager |
| 16 | Gasoline | Standard Van (luxury) | Dodge Ram Van |
| 17 | Gasoline | Standard Van (standard) | Ford Econoline |
| 18 | Gasoline | Compact Sport Utility | Nissan Pathfinder |
| 19 | Gasoline | Standard Sport Utility | GMC Jimmy |
| 20 | Gasoline | Mini Sport Utility | Suzuki Samurai |
| 21 | CNG | Subcompact Car | Honda Civic |
| 22 | CNG | Large Car | Ford Crown Victoria |
| 23 | CNG | Standard Truck | Ford F-150 |
| 24 | CNG | Standard Van | Ford Econoline |
| 25 | Bi-Fuel | Compact Car | Ford Contour |
| 26 | Bi-Fuel | Standard Truck | Ford F-150 |
| 27 | Electric | Mini Car | Honda EV Plus |
| 28 | Electric | Subcompact Car | GM EV1 |
| 29 | Electric | Compact Pickup | Ford Ranger |
| 30 | Electric | Compact Van | Chrysler EPIC EV |

Source: California Energy Commission, Demand Analysis Office

Table B-4: Vehicle Class-Specific Attributes Used in Forecasts

| Attribute | Description |
|---|--|
| Acceleration | 0-30 mph, in seconds |
| Top speed | Mph |
| Tailpipe emissions | Percentage of a 1993 gasoline vehicle |
| Dual fuel capability | Yes or no, gasoline and alternative fuel |
| Service station fuel availability | Percentage of gasoline stations |
| Home refueling or recharging capability | Yes or no |
| Luggage space | Percentage of comparable gasoline vehicle |
| Fuel operating cost | Cents per mile |
| Purchase price | In dollars |
| Range | In miles, on a full tank or charge |
| Home refueling time | In minutes, for vehicles with this capability |
| Service station refuel or recharge time | In minutes |
| Fuel type | Electric, compressed natural gas, methanol, or gasoline |
| Size | Mini, subcompact, compact, midsize, large |
| Body style | Standard car, station wagon, sports car, pickup truck, van, sport utility |

Source: California Energy Commission, Demand Analysis Office

Table B-5: Vehicle Characteristics for Subcompact Car for Various Years

| Year | Fuel Type | Price (98\$) | Fuel Economy** | Acceleration | Top Speed | Range | Emissions | Battery Replacement Cost (98\$) |
|------|-----------|--------------|----------------|--------------|-----------|-------|-----------|---------------------------------|
| 2000 | Gasoline* | 14,725 | 29.75 | 3.59 | 108 | 454 | 0.57 | -- |
| | CNG | 18,820 | 31.24 | 3.87 | 103 | 152 | 0.40 | -- |
| | Electric | 43,635 | 3.70 | 2.98 | 80 | 120 | 0 | 15,567 |
| 2005 | Gasoline* | 15,419 | 31.46 | 3.53 | 109 | 480 | 0.50 | -- |
| | CNG | 19,364 | 31.79 | 3.78 | 104 | 155 | 0.40 | -- |
| | Electric | 42,809 | 3.69 | 2.92 | 80 | 120 | 0 | 13,512 |
| 2010 | Gasoline* | 15,658 | 33.73 | 3.43 | 111 | 515 | 0.50 | -- |
| | CNG | 19,607 | 34.09 | 3.67 | 106 | 166 | 0.40 | -- |
| | Electric | 41,623 | 3.73 | 2.83 | 80 | 120 | 0 | 11,588 |
| 2015 | Gasoline* | 15,827 | 34.95 | 3.33 | 113 | 534 | 0.50 | -- |
| | CNG | 19,780 | 35.32 | 3.56 | 108 | 171 | 0.40 | -- |
| | Electric | 40,587 | 3.78 | 2.75 | 80 | 120 | 0 | 9,920 |

* Standard (non-luxury) class.

** For gasoline and CNG, miles per gasoline-equivalent gallon (where one gallon = 1.11 therms); for electric, miles per kWh.

Source: Energy and Environmental Analysis

Notes

¹ Ten percent penetration of new light-duty vehicles as defined by the California Air Resources Board: cars plus light-duty trucks with loaded vehicle weight of 0-3,750 pounds. Approximately 50 percent of all light-duty trucks (as defined by the Energy Commission) fall into this category, based on the DMV unladen weight report. To achieve this level of penetration, EV purchase prices were reduced to those of similar gasoline vehicles, and battery replacement cost was reduced to zero by 2003.

² The growth rate between 1997 and 2015 ranges from 15 to 28 percent, depending on the vehicle class.

³ Estimates come from the Los Angeles County Metropolitan Transit Authority, the California Natural Gas Vehicle Coalition, the Sacramento Regional Transit District, and the *1997 Transit Vehicle Data Book*, by the American Public Transit Association.

⁴ Economic/demographic projections come from the Center for the Continuing Study of the California Economy (CCSCE), 1998.

⁵ Calibration constants are added to each class and vintage of gasoline LDV so that base year (1995) stock projections by class/vintage match actual counts from DMV records (see also appendix).

⁶ From DRI/McGraw Hill, 8/97.

⁷ *California Economic Growth*, 1998 Edition. (Palo Alto, CA: Center for Continuing Study of the California Economy).

⁸ CCSCE provides projections only through 2005, and therefore was not used for a long-term forecast.